

Claims:

1. A method of decomposing a thermosetting resin by a decomposer, comprising the steps of:

pre-heating the thermosetting resin up to a preheating temperature T0;

kneading the pre-heated thermosetting resin together with a decomposer, and concurrently heating a mixture comprising the thermosetting resin and the decomposer up to a kneading temperature T1, thereby allowing a reaction to take place between the decomposer and the thermosetting resin to obtain a kneaded matter wherein the decomposer becomes consumed; and

heating said kneaded matter to a maximum temperature T2 to decompose the thermosetting resin; wherein:

said pre-heating temperature T0 is not higher than the boiling temperature of said decomposer;

said kneading temperature T1 is not lower than said pre-heating temperature T0 but is lower than the thermal decomposition temperature of the thermosetting resin;

said maximum temperature T2 is lower than the thermal decomposition temperature of the thermosetting resin; and

said pre-heating of the thermosetting resin is performed under the following conditions of temperature T0 and time t:

$$100^{\circ}\text{C} \leq T0 < 260^{\circ}\text{C}$$

$$0.5 \text{ min} \leq t \leq 7 \text{ min.}$$

2. The method according to claim 1, wherein said preheating step is performed under the following conditions of temperature T0 and time t:

$$100^{\circ}\text{C} \leq T0 \leq 230^{\circ}\text{C}$$

$$3.375 \leq 0.0125T0 + t \leq 8.25$$

3. The method according to claim 1, wherein said kneading step of thermosetting resins and decomposers is continued, while monitoring the quantity of residual decomposer, until the quantity of residual decomposer is reduced to less than 10%.

4. The method according to claim 1, wherein the thermosetting resin and the decomposer are present in the mixture in a ratio of thermosetting resin : decomposer of 2:3 to 1:20, based on weight.

5. The method according to claim 4, wherein ratio is 1:5 to 1:7, based on weight.

5 6. The method according to claim 1, wherein a temperature during said kneading step is maintained substantially constant, and the final temperature T1 thereof is substantially identical with the preheating temperature T0.

7. The method according to claim 1, wherein the final temperature T1 in said kneading step is higher than the preheating temperature T0.

10 8. The method according to claim 1, wherein said decomposer is enabled to react with and attach to said thermosetting resin during the kneading step, thereby producing an intermediate product.

15 9. The method according to claim 8, wherein the boiling point of said intermediate product to be produced during the kneading step is higher than the boiling point of said decomposer.

10. The method according to claim 8, wherein said thermosetting resin comprises a resin having a carbonyl group.

20 11. The method according to claim 10, wherein said resin having a carbonyl group is selected from the group consisting of urethane resin, urea resin and unsaturated polyester, and said intermediate product is produced through attaching of said decomposer to a carbon atom of said carbonyl group.

12. The method according to claim 11, wherein said decomposer comprises an amine compound, and said intermediate product is produced through attaching of a nitrogen atom of said amine compound to a carbon atom of said carbonyl group.

13. The method according to claim 12, wherein said amine compound is an alkanol amine.

14. The method according to claim 13, wherein said alkanol amine is monoethanol amine.

5 15. The method according to claim 13, wherein said alkanol amine is diethanol amine.

16. The method according to claim 13, wherein said alkanol amine is triethanol amine.

10 17. The method according to claim 11, wherein said decomposer comprises a compound having a hydroxyl group, and said intermediate product is produced through attaching of an oxygen atom of said hydroxyl group to a carbon atom of said carbonyl group.

18. A decomposition apparatus for decomposing a thermosetting resin by the method claimed in claim 1, wherein said apparatus comprises:

- 15 a chamber for accommodating the thermosetting resin;  
a temperature controllable heating means for heating said chamber;  
a decomposer supply means for feeding a decomposer to said chamber;  
a monitoring means for detecting a quantity of residual decomposer left in said chamber; and  
a temperature control means for controlling said heater on the basis of the quantity of  
20 residual decomposer.

19. A control program for controlling heating of a thermosetting resin in a decomposition process of said thermosetting resin, wherein said program comprises the steps of:

- 25 instructing a computer to heat a chamber accommodating the thermosetting resin up to a temperature T0;  
instructing the computer to determine if said temperature T0 of said chamber is in the

range of 100 to 260°C, and if heating time is in the range of 0.5 min to 7 min;

instructing the computer, when it is determined that said temperature T0 of said chamber is in the range of 100 to 260°C, and said heating time is in the range of 0.5 min to 7 min, to feed a decomposer to said chamber for a decomposition of the thermosetting resin;

5        instructing the computer to heat said chamber at a temperature of less than the thermal decomposition temperature of the thermosetting resin;

instructing the computer to detect the quantity of residual decomposer left in said chamber;

10        instructing the computer to determine if the quantity of residual decomposer is less than 10%;

instructing the computer, when it is determined that the quantity of residual decomposer is not less than 10%, to continue heating of said chamber while keeping the temperature of the thermosetting resin to less than the decomposition temperature of the thermosetting resin; and

15        instructing the computer, when it is determined that the quantity of residual decomposer is less than 10%, to raise a maximum temperature from a temperature T1 at this moment up to T2, which is higher than T1.